

DESIGN OF A CORRECTING PLATE FOR COMPENSATING THE MAIN REFLECTOR DISTORTIONS OF A DUAL SHAPED SYSTEM⁺

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We present a method of synthesizing a correcting 'flat' plate that compensates for the main reflector distortions for the geometry shown in Fig. 1. The dual shaped reflector system, synthesized for high gain has a main reflector diameter of 32.8m (not including a noise shield). The procedure for the synthesis of the dual shaped reflector is described in [1]. The time and space slowly varying surface distortions in the main reflector are due to gravitational and thermal effects and reduce the antenna gain. There is thus a need to compensate for such distortions. The correcting plate is nominally flat and part of a beam waveguide. It is designed by geometrical optics (GO) to be distorted so as to have a virtual point caustic for the GO rays reflected off the 'flat' plate (in receiving mode).

The actual source for the correcting plate is a *converging* field. In the physical optics (PO) analysis, a source is placed at the virtual center in the feed coordinates ($x_f=0, y_f=0, z_f=0$) and the currents on the 'flat' plate are then 'conjugated' to form the convergent field with a virtual caustic below the correcting plate. Fig. 2 shows a view of the shaped main reflector with the distortion obtained from holographic measurements. Fig. 3 shows the distorted main reflector magnified by a factor 3000. The maximum distortion is about 1.5 mm, a substantial amount at 32 GHz.

The synthesized 'flat' plate is shown in Fig. 4. Without magnifications distortions are not visible. This figure is obtained with the interpolat-
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tion software necessary for the diffraction analysis. Only the GO illuminated portions of the 'flat' plate are depicted. Fig. 5 shows the distortions in the 'flat' plate with a magnification of 100. The distortions are thus visible, and are found to be 'opposite' to that of the main reflector distortions. The distortions, presented in feed coordinates, may be realized by mechanical actuators. Interpolation errors that occur near the edge of the 'flat' plate are not significant since the field strength in that region is -20 dB or less with respect to the field at the center of the 'flat' plate. There is some minor interpolation error at the center due to the vertex plate in the subreflector. The PO analysis of the 'flat' plate and the subreflector was initially carried out at 2.5 GHz in a personal computer whereas at 32 GHz a main frame computer is useful. At 2.5 GHz gravitational distortions are negligible.

Figs. 6 and 7 illustrate the scattered fields, (from the subreflector incident upon the shaped main reflector) obtained by PO analysis of the 'flat' plate and the subreflector. Fig. 6 shows the $\phi=0$ or x-z plane pattern cut. Reference center for this cut is at $z=500$ in. or at the center of distributed virtual caustic on z-axis. In Fig. 1, the other virtual caustic behind the subreflector is found to be distributed because of shaping. The 'average' caustic center makes an incident angle of about 75 degrees to the edge of the main reflector. The inverse taper from the angle 0 deg. to the main reflector edge intercept at about 75 deg. is typical of dual reflectors shaped for uniform high gain aperture distributions. The intercept at 75 deg. is on the downward slope typical of the Gibb's phenomenon of the fields incident on main reflectors from subreflectors. The polarization is x-directed (see Fig. 1). No cross polarization exists in the $\phi=0$ cut. Fig. 7 depicts a scattered pattern cut in the $\phi=\pi/2$ or y-z plane. This cut is out of the paper (see Fig. 1). In this case, the cross polarization is not zero.

References

- [1] V. Galindo-Israel, W.A. Imbriale, and R. Mittra, IEEE Trans. Antennas Propagat., vol. AP-35, pp. 887-896, Aug. 1988.

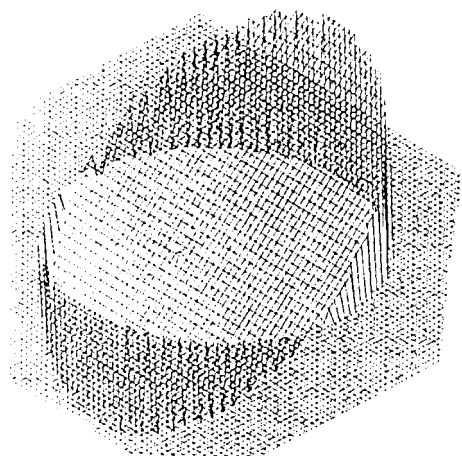


Fig. 4 A view of the 'flat' plate

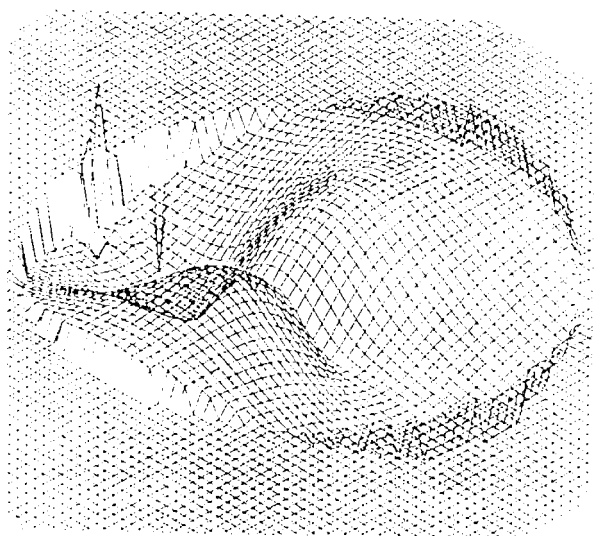


Fig. 5 'Flat' plate distortion magnified by a factor of 100

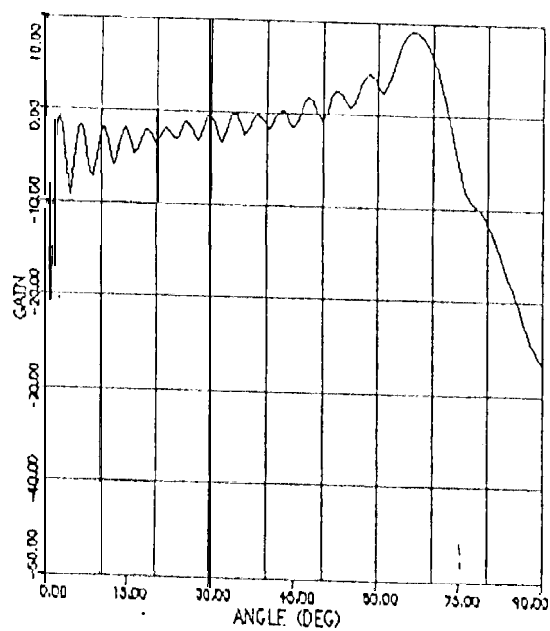


Fig. 6 Scattering from the sub reflector, $\phi=0$ deg. cut

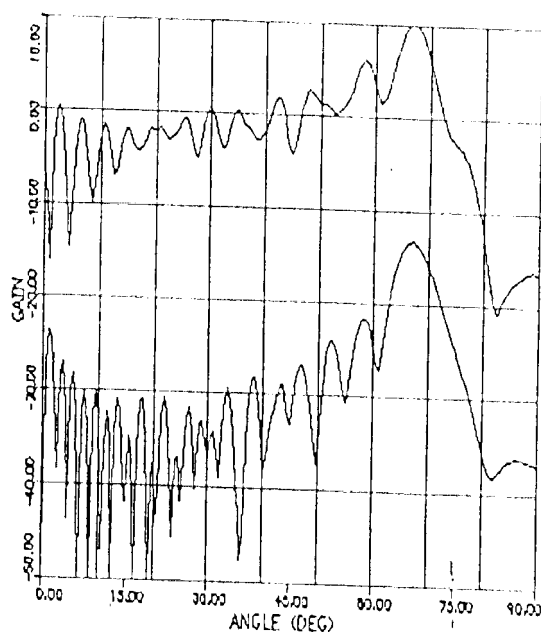


Fig. 7 Scattering from the sub reflector, $\phi=90$ deg. cut